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SPRAY TESTS FOR CONTROL OF POTATO BLIGHT IN THE HILLS OF WEST BENGAL[1]

H. C. CHOUDHURI[2]

The hilly areas of Darjeeling are the important centers of seed production in West Bengal. These potato growing centers are mainly concentrated in Rhimbic, Lodhama, Srikhola, Manibhanjang and Semana at an altitude of 5,000 to 8,000 ft.

Two potato crops are grown in the hills of Darjeeling, one in the summer and other in the winter, the former being the main crop. In summer, practically all the seeds are planted during mid-December and January and the crop harvested in early August. In winter the planting is done by September or October and the crop harvested by March. Darjeeling Red Round and Great Scot are the two leading varieties.

Late blight of potatoes caused by *Phytophthora infestans* (Mont.) de Bary, takes a heavy toll of the potatoes, particularly the summer crop. Several factors tend to make the control of foliage diseases difficult particularly during the summer. The main potato crop is planted during the short days of winter rather than the longer days of the summer growing season. Although rain is infrequent during winter months, dew formation and frosting are heavy, often beginning by 6:00 p.m. with the result that the plants remain wet until 9:00 a.m. the following day. Moreover, foliage injury results from occasional hails. With the onset of summer, heavy rainfall occurs. These conditions are very favorable for the rapid development of plant diseases.

Late blight is the only foliage disease of importance. The early blight caused by *Alternaria Solani* (E & M) J & G, has been found to infect the leaves and is soon replaced by late blight as the most serious foliage trouble.

Field trials for control of foliage blight of potatoes have been conducted annually since the 1945-1946 season. In the first three seasons it was unprofitable to spray with Bordeaux mixture for blight control. Various formulations of Bordeaux mixture did not increase the yield sufficiently so the use of this mixture was discontinued. Bonde and Snyder (1) reported in their work that plots sprayed with Bordeaux mixture had a depressing effect on yields. Since 1949 various fungicidal sprays or dusts have been used experimentally, and have given significant and profitable increases in yield. Wet sprays were also found to be more effective than dust treatments.

During summer, the weather is moist and late blight usually appears during the early part of June. It is widespread and destructive by the second week of June. In many fields it is well established in the foliage of young plants before they are fully grown. Under these conditions, control of the disease and increases in yield were unsatisfactory with Bordeaux mixture. Under these severe late blight conditions, Perenox and Dithane gave some outstanding increases in yield in the test plots as compared with other fungicides.

[1]Accepted for publication November 24, 1953.

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The experiments with Perenox and Dithane, in comparison with other fungicides used during the three seasons, produced results of particular interest and are discussed in this paper.

Materials and Methods

All experiments were made with local Darjeeling Red Round potatoes, a variety very susceptible to *Phytophthora infestans*, (Mont) de Bary. The tubers were planted in January and harvested in August after the foliage was dead.

The experiment was laid out according to statistical rules. The treatments were randomized and were replicated four times in various tests. The fungicides were applied with a hand-operated air sprayer. The various treatments were applied on the same day and were started when the plants were 6" high in the middle of March. Sprays were repeated once in 14 days, 10 days, 8 days, and 6 days for a total of 8 to 18 applications. Approximately 100 gallons per acre were applied during the first three applications, raising it to 150 gallons per acre for the rest.

Table 1.—*Results of spray test on potatoes with Perenox, Dithane, Soltosan and Perelan at intervals of 14 days.*

Average figures for three seasons 1949-1950 to 1951-1952.

Fungicides*	Formulae Pounds in 100 Gallons of Water	Percentage of Foliage Killed by Late Blight Days after Planting 121	136	151	Yield per Acre (in Mds.)***	Percentage Increase in Yield over Check
Perenox	1.25	4	49.0	100	38.37	5.7
	2.50	2	47.3	100	48.27	33.7
	3.00	1	46.0	91	57.80	59.2
	5.00	....	38.8	89	58.11	60.0
Dithane	1.25	3	67.4	100	52.18	43.7
	2.50	2	51.5	100	54.29	49.6
	3.00	1	51.3	98	57.12	57.3
	5.00	1	38.1	95	57.80	59.2
Soltosan	3.00	9	67.5	100	37.23	2.5
	7.50	6	65.0	100	38.30	5.3
	10.00	5	58.7	97	38.37	5.7
	12.50	3	47.3	96	39.18	7.9
Perelan**	5.00	10	70.2	100	38.20	5.2
	7.50	8	68.0	100	38.30	5.5
	10.00	7	55.0	100	39.18	7.9
	12.50	5	48.8	98	40.00	10.2
Check	Untreated	20.0	100.0	100	36.30	

*Active ingredients; Perenox—a specially prepared cuprous oxide containing 50 per cent copper; Dithane—disodium ethylene bisdithiocarbamate; Soltosan—contains 50 per cent copper; Perelan—contains 17.5 per cent copper.

**Dust in lbs. per acre.

***1 Md = 82 pounds.

Experimental Data

Table 1 shows the incidence of foliage killed and the yield data of the experimental plot in which fungicidal sprays of different formulations have been applied at an interval of 14 days. Blight appeared in the test plots during the first week of June and by the second week of June it established itself very firmly.

Figure 1 and table 1 show that increasing the strength of the fungicides did not seem to increase their effectiveness appreciably for control of potato blight because of frequent rains, but the yield was increased appreciably. Table 2 represents the data for percentage of foliage killed by late blight 121, 136 and 151 days after planting and the yield obtained from these treatments when applied every 10 days.

It is apparent from the two tables that the blight was successfully controlled up to 121 days after planting when the sprays were applied at intervals of 10 days. But the percentage of foliage killed 136 days after planting was quite high. Figure 2 shows the effect on yield from spraying the spray concentration when applied at ten days' interval.

In table 3 and figure 3 are summarized the results obtained after spraying at an interval of 8 days.

Leaf infection was not seen 121 days after planting. The above data show that the percentage of foliage killed increased with the increase of interval of sprays. The results obtained by spraying at an interval of 6 days are given in table 4 and figure 4.

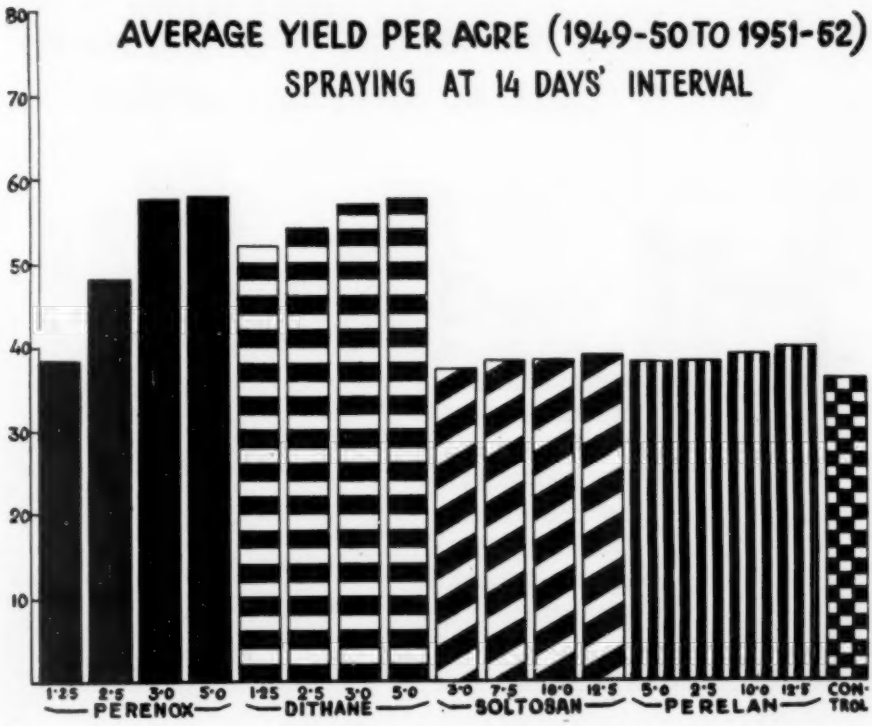


Figure 1.—Increase in yield of potatoes due to different fungicidal sprays at intervals of 14 days.

TABLE 2.—*Results of spray test on potatoes with Perenox, Dithane, Soltosan and Perelan at intervals of 10 days.*
Average figures for three seasons 1949-1950 to 1951-1952.

Fungicides	Formulae Pounds in 100 Gallons of Water	Percentage of Foliage Killed by Late Blight Days after Planting 121	136	151	Yield per Acre (in Mds.)	Percentage Increase in Yield over Check
Perenox	1.25	Nil	31.2	96.5	48.25	49.9
	2.50	Nil	18.7	92.1	50.11	55.7
	3.00	Nil	10.2	82.0	55.10	71.2
	5.00	Nil	.....	66.1	56.20	74.6
Dithane	1.25	Nil	25.8	84.1	38.18	21.7
	2.50	Nil	25.0	81.0	42.28	31.6
	3.00	Nil	18.7	80.1	47.10	49.5
	5.00	Nil	11.0	65.8	52.18	62.5
Soltosan	3.00	5.0	30.0	98.0	33.36	3.7
	7.50	5.0	25.0	99.0	34.32	6.6
	10.00	Nil	11.0	95.0	35.16	9.3
	12.50	Nil	11.0	80.0	35.38	9.9
Perelan	5.00	6.1	32.5	100.0	33.32	3.5
	7.50	4.5	28.0	98.5	36.90	14.7
	10.00	Nil	25.5	95.0	36.30	12.8
	12.50	Nil	20.0	90.0	36.90	14.7
Check Untreated		25.0	100.0	100.0	32.17	

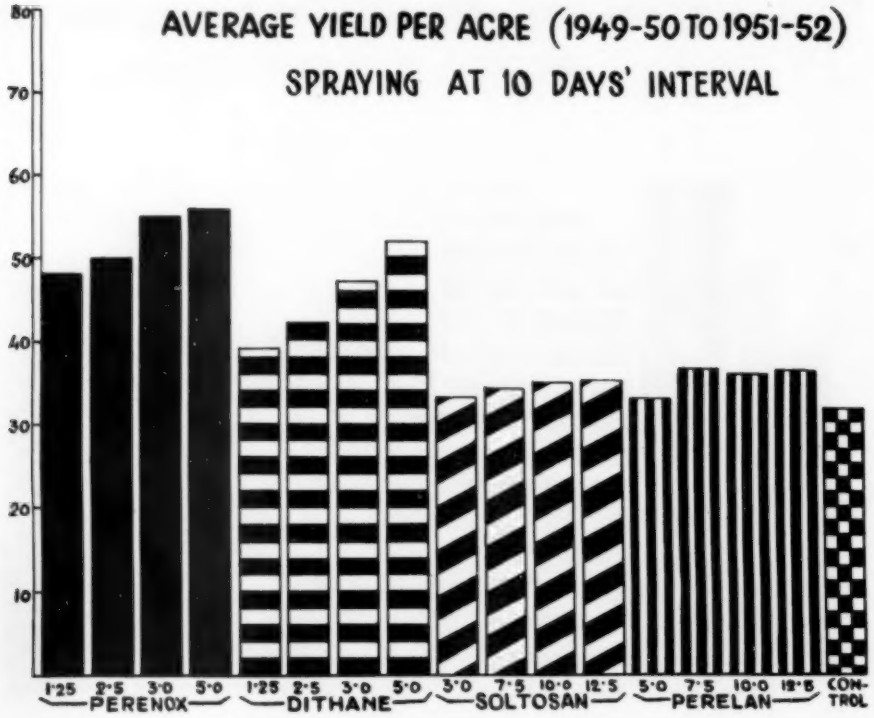


FIGURE 2.—Increase in yield of potatoes due to sprays at intervals of 10 days.

TABLE 3.—*Results of spray test on potatoes with Perenox, Dithane, Soltosan and Perelan at intervals of 8 days.*

Average figure for three seasons, 1949-1950 to 1951-1952.

Fungicides	Formulae Pounds in 100 Gallons of Water	Percentage of Foliage Killed by Late Blight Days after Planting 121	136	151	166	Yield per Acre (in Mds.)	Percentage Increase in Yield over Check
Perenox	1.25	.....	.....	12.5	67.1	58.15	69.8
	2.50	.....	.....	12.0	58.3	58.16	69.8
	3.00	.....	.....	11.2	51.9	63.31	84.9
	5.00	.....	.....	10.0	47.7	65.38	90.9
Dithane	1.25	.....	.....	13.7	70.3	49.29	43.9
	2.50	.....	.....	9.2	68.0	50.11	46.3
	3.00	.....	.....	9.0	66.0	53.31	55.6
	5.00	.....	.....	6.2	48.0	62.28	81.8
Soltosan	3.00	.....	.....	22.2	89.0	41.14	20.1
	7.50	.....	.....	21.0	85.7	48.27	40.9
	10.00	.....	.....	25.0	84.3	49.29	43.9
	12.50	.....	.....	25.0	84.0	50.32	46.9
Perelan	5.00	.....	10.0	31.2	100.0	34.34	0.2
	7.50	.....	8.7	21.7	98.0	42.60	23.3
	10.00	.....	5.5	25.0	95.7	38.37	12.0
	12.50	.....	3.0	21.7	89.2	55.29	61.3
Check	Untreated	21.0	100.0	100.0	100.0	34.24	

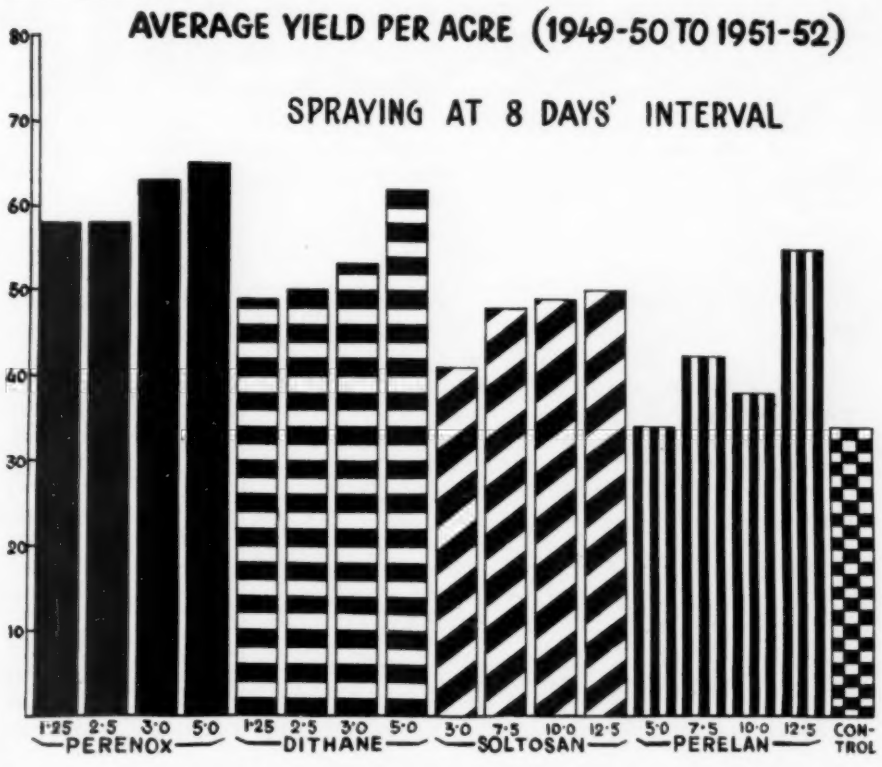


FIGURE 3.—Increase in yield of potatoes due to fungicidal sprays at intervals of 8 days.

TABLE 4.—*Results of spray test on potatoes with Perenox, Dithane, Soltosan, and Perelan at an interval of 6 days.*

Average figure for three seasons, 1949-1950 to 1951-1952.

Fungicides	Formulae Pounds in 100 Gallons of Water	Percentage of Foliage Killed by Late Blight Days after Planting 121	136	151	166	Yield per Acre (in Mds.)	Percentage Increase in Yield over Check
Perenox	1.25	.....	.....	10.5	60.8	63.80	88.9
	2.50	.....	.....	9.0	53.5	70.11	110.9
	3.00	.....	.....	8.0	33.9	72.39	120.8
	5.00	.....	.....	7.7	20.0	78.37	135.8
Dithane	1.25	.....	.....	11.2	58.9	49.29	48.3
	2.50	.....	.....	7.5	52.5	62.39	87.7
	3.00	.....	.....	6.2	32.8	70.17	110.8
	5.00	.....	.....	5.0	22.6	78.37	135.8
Soltosan	3.00	.....	.....	25.0	70.5	48.40	45.6
	7.50	.....	.....	20.5	65.8	56.30	69.4
	10.00	.....	.....	18.5	58.0	56.30	71.2
	12.50	.....	.....	17.5	45.7	57.12	71.8
Perelan	5.00	.....	.....	18.2	80.7	40.21	21.0
	7.50	.....	.....	17.2	79.0	45.16	35.5
	10.00	.....	.....	17.2	55.0	47.23	42.1
	12.50	.....	.....	16.5	50.2	52.17	56.9
Check	Untreated	27.0	100.0	100.0	100.0	33.23	

Leaf infection was not seen 136 days after planting. All treatments outyielded the unsprayed checks. Perenox and Dithane treatments significantly outyielded all other treatments.

DISCUSSION

Bordeaux mixture has long been considered as one of the best fungicides for the control of blight diseases of potato, but in hill conditions of Darjeeling where the rainfall is high it did not seem to be effective in controlling the disease. Further it had a depressing effect on yield rate according to Bonde and Snyder (1). The data presented show that none of the fungicides tested can completely control the disease until the haulms are yellow. The early summer crop which is planted by January matures by July and therefore takes about 6 months to reach full maturity. Spraying with Perenox and Dithane can check the blight disease completely only until the end of June, *i.e.* 136 days after its planting.

From table 5 and figure 5 it is seen that the fungicides were more effective when they were sprayed at shorter intervals of 6-8 days. Even higher strengths were not effective at longer intervals.

The failure of fungicides to control the late blight was presumably caused partially by the poor adherence of sprays to the leaves, Davidson and Rich (2). Vaughn and Leach (6) in their comparison of certain potato sprays in different localities, considered that because of variation

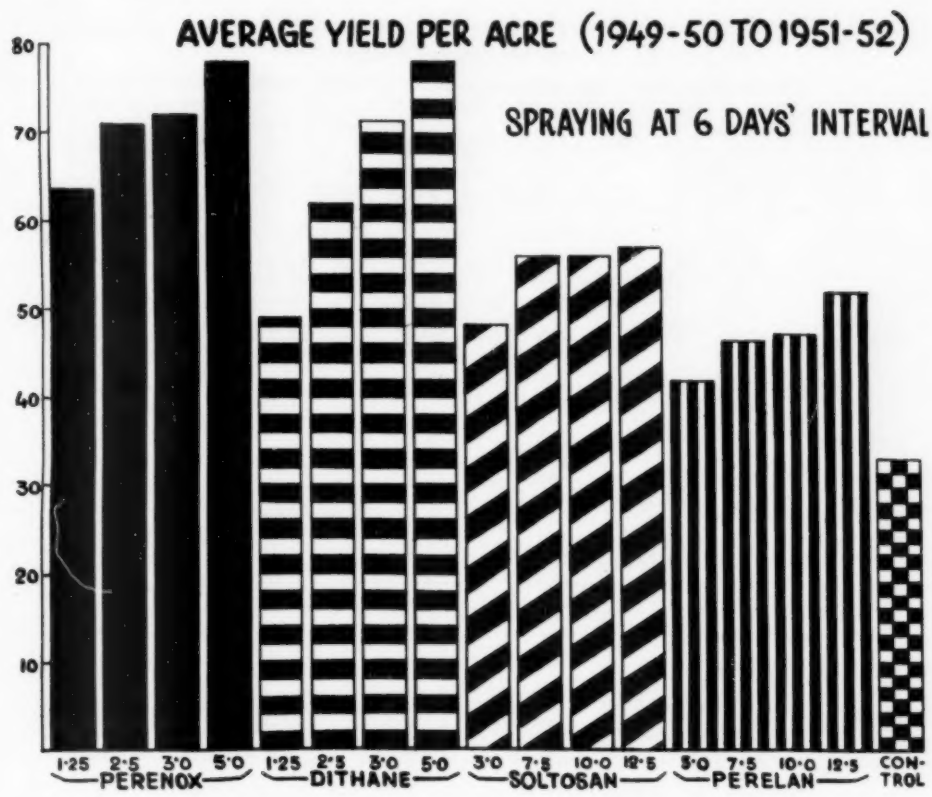


FIGURE 4.—Increase in yield of potatoes due to fungicidal sprays at intervals of 6 days.

in climatic conditions spray materials vary in their effectiveness in different localities.

Under high rainfall conditions in the hills of Darjeeling, only a fungicide with good adhesive properties can be effective. It may be pointed out that during June and July it rains almost continuously, so the spray seldom becomes effective because of continuous rains. During the present experiment it was further observed that Soltosan and Perelan remained effective only for a few days after application, after which these appeared to have lost their effectiveness and failed to check the destruction of the leaves by the disease. Perenox and Dithane proved effective when applied at intervals of 6 to 8 days. Ruehle (4) demonstrated that Dithane + lime + zinc sulphate remained effective up to 7-day intervals of spray.

From table 6 it is seen that Perenox and Dithane did permit the potatoes to produce a larger yield. This increase in percentage of yield was most remarkable in the case of Perenox and Dithane when sprayed at 6-day intervals. Similar increases in yield in out-turn affected by these fungicides have been reported by Vasudeva and Azad (5), and Reuhle (4). Horsfall and Turner (3) suggested that this increase in yield is due to lower phytotoxicity of the fungicides.

TABLE 5.—*Comparative percentages of foliage killed when sprayed at an interval of 6-14 days.*

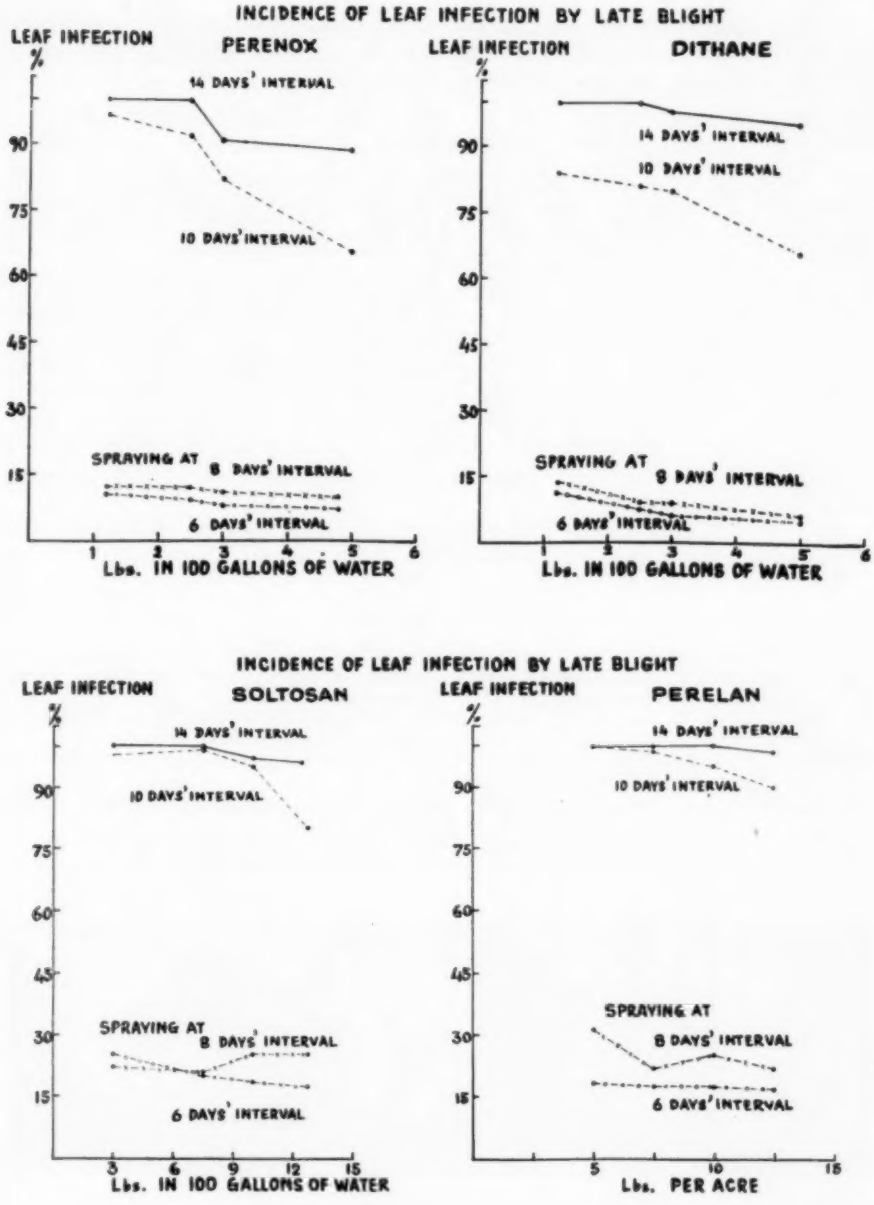
Average figure for three seasons, 1949-1950 to 1951-1952.

Fungicides	Formulae Pounds in 100 Gallons of Water	Percentage of Foliage Killed on 1st of July *i.e.* 151 Days after Spraying at Intervals of 14 Days	10 Days	8 Days	6 Days
Perenox	1.25	100	96.5	12.5	10.5
	2.50	100	92.1	12.0	9.0
	3.00	91	82.0	11.2	8.0
	5.00	89	66.1	10.0	7.7
Dithane	1.25	100	84.1	13.7	11.2
	2.50	100	81.0	9.2	7.5
	3.00	98	80.1	9.0	6.2
	5.00	95	65.8	6.2	5.0
Soltosan	3.00	100	98.0	22.2	25.0
	7.50	100	99.0	21.0	20.5
	10.00	97	95.0	25.0	18.5
	12.50	96	80.0	25.0	17.5
Perelan	5.00	100	100.0	31.2	18.2
	7.50	100	98.5	21.7	17.2
	10.00	100	95.0	25.0	17.2
	12.50	98	90.0	21.7	16.5
Check	Untreated	100	100	100	100

TABLE 6.—*Comparative percentages of increase in yield over the check when sprayed at intervals of 14, 10, 8, and 6 days.*

Average figure for three seasons, 1949-1950 to 1951-1952.

Fungicides	Formulae Pounds in 100 Gallons of Water	Percentage of Foliage Killed on 1st of July *i.e.* 151 Days after Spraying at Intervals of 14 Days	10 Days	8 Days	6 Days
Perenox	1.25	5.7	49.9	69.8	88.9
	2.50	33.0	55.7	69.8	110.9
	3.00	59.2	71.2	84.9	120.8
	5.00	60.0	74.6	90.9	135.8
Dithane	1.25	43.7	21.7	43.9	48.3
	2.50	49.6	31.6	46.3	87.7
	3.00	57.3	49.5	55.6	110.8
	5.00	59.2	62.5	81.8	135.8
Soltosan	3.00	2.5	3.7	20.1	45.6
	7.50	5.5	6.6	40.9	69.4
	10.00	5.7	9.3	43.9	71.2
	12.50	7.9	9.9	46.9	71.8
Perelan	5.00	5.2	3.5	0.2	21.0
	7.50	5.5	14.7	23.3	35.5
	10.00	7.9	12.8	12.0	42.1
	12.50	10.2	14.7	61.3	56.9
Control		36.30	32.17	34.24	33.23



FIGURES 5 & 6.—Effect of Perenox, Dithane Soltosan and Perelan on the incidence of late blight.

Acknowledgment

The author desires to thank Dr. H. K. Nandi, Director of Agriculture for his criticism. Thanks are also due to Mr. D. K. Pal, Inspecting Officer, Potatoes, for his assistance.

Summary

1. Spray tests have been carried out with various fungicides for the control of late blight in high rainfall conditions in the hills of Darjeeling, West Bengal. Control of disease and increase in yield were unsatisfactory when treated with Bordeaux mixture.

2. Perenox, Dithane, Soltosan and Perelan were applied at different intervals *viz.*, 6, 8, 10 and 14 days at various strengths. Under severe late blight conditions Perenox and Dithane gave better results than did the other fungicides, and the percentage of leaf infection was found to be less in plots treated with Perenox and Dithane. Spraying at an interval of 6-8 days was found more effective particularly in the month of June when rainfall is usually high. Shorter intervals of sprays, even with a lower strength of fungicide, was found more effective than higher strengths at longer intervals.

3. Increase in yield was obtained from all treated plots but was most noticeable in case of Perenox.

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THE OSSEO VARIETY[1]

F. A. KRANTZ,[2] C. J. EIDE,[2] C. H. GRIFFITH,[2]
B. C. BERESFORD,[2] O. C. TURNQUIST,[2] M. J. THOMPSON[2]
AND A. G. TOLAAS[3]

The "Osseo" variety of potato is a selection from a cross of Cobbler with selection 56-1. The latter was obtained through cycles of inbreeding and outbreeding as indicated in Chart 1. The final cross was made in the field at University Farm in 1940, the hybrid seed sown September 26, 1940 in the greenhouse, and the seedlings harvested in December. Three selections were made from the 48 seedlings in the family grown in the field in 1941 at the North Central Experiment Station at Grand Rapids, Minnesota. Observations in 1942 indicated that one of these selections had some exceptional characters, *i.e.* short season, upright compact foliage, broad leaves, and no tubers under two inches in diameter. This selection designated as Minnesota 23 was placed in preliminary trials in 1943 and 1944 where the yield could be compared with Waseca and Red Warba, varieties with the same maturity season.

In 1943 the yield of Minnesota 23 was equal to the Waseca and both yielded less than the Red Warba (Table 1). In 1944 no yields were recorded, but the varieties were rated on general desirability. Minnesota 23 and Waseca rated about the same and both were above the Red Warba. At none of the seven locations did these varieties rate lower than the Red Warba.

From 1945 to 1950 inclusive, the variety Osseo (Minn. 23) was in the regular adaptation tests. The yield of Osseo for this period for four potato growing regions of the state is given in table 2. In these adaptation tests the yield of the Osseo was about the same as those of the Red Warba and the Waseca.

The Osseo is exceptional in the high percentage of tubers of marketable size. As shown in table 3, a consistently high per cent of its yield was over 2¼″ in diameter at all locations in 1947. This characteristic of the variety is indicated more clearly in the percentages over 2⅝″ obtained in 1948. In this respect the Osseo was nearly always superior to the 11 other varieties tested.

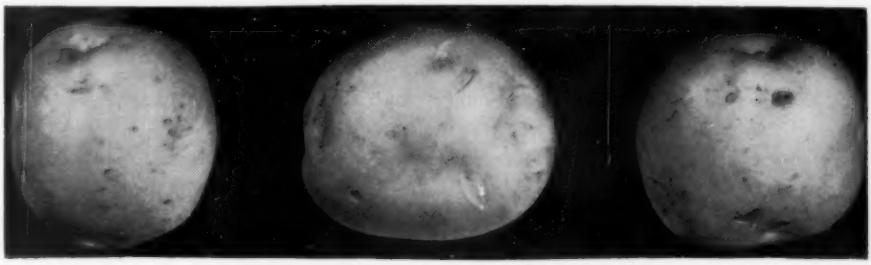
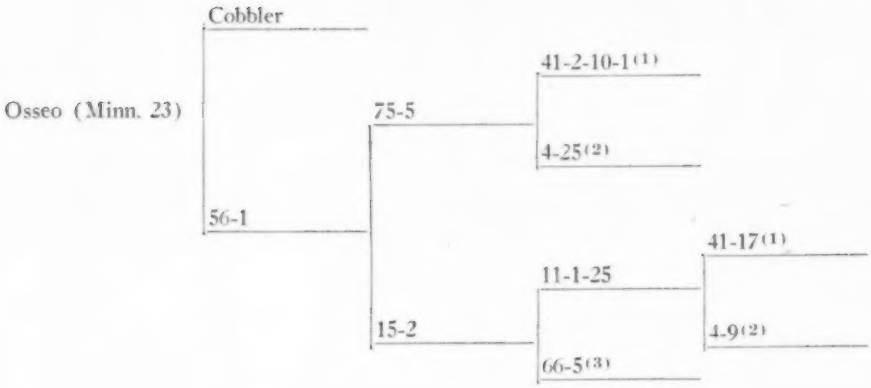


FIGURE 1.—Typical tubers of the Osseo variety.

[1]Accepted for publication January 18, 1954.
Paper No. 3097 of the Scientific Journal Series of the Minnesota Agriculture Experiment Station.
[2]Institute of Agriculture, University of Minnesota, St. Paul 1, Minn.
[3]State Department of Agriculture.

CHART 1.—*Parentage of Osseo.*



1. Line 41.—Original stock was seed collected by a grower from a plant in a field of Early Ohio potatoes.
2. Line 4.—Selection from F_1 (Keeper X Silverskin) selfed.
3. Line 66.—Selection from Katahdin selfed.

TABLE 1.—*Yields — Minnesota 23 (Osseo), Waseca, and Red Warba varieties in 1943 and desirability ratings in 1944.*

Variety	1943		1944	
	Locations	Per Acre	Locations	General Desirability Rating
	Number	Bushels	Number	1 to 10 high Scale
Minnesota 23	8	153.3	7	7.5
Waseca	8	151.3	7	7.4
Red Warba	8	165.2	7	6.5

TABLE 2.—*Yield of Osseo, Red Warba and Waseca for period 1945 to 1950 inclusive.*

Variety	Red River Valley		Late Region		Early Market Region		Peat Land		Average for 4 Regions
	Tests	Yield Per Acre	Tests	Yield Per Acre	Tests	Yield Per Acre	Tests	Yield Per Acre	
	No.	Bushels	No.	Bushels	No.	Bushels	No.	Bushels	
Osseo	32	219	24	297	12	183	16	388	272
Red Warba	32	212	24	270	12	208	16	384	269
Waseca	32	207	24	281	12	172	16	365	256

TABLE 3.—*Per cent of total yield over 2¼" in diameter in 1947 and over 2⅝" in 1948.*

Variety	Grand Rapids	Hollandale Loc. 1	Hollandale Loc. 2	Excelsior	Glyndon	Halstad	East Grand Forks	Princeton	Kennedy	Glyndon	Hollandale	Bagley
	Per cent of Yield over 2¼" in Diameter									Over 2⅝" in Diameter		
Osseo	93.2	96.3	94.6	94.5	95.9	97.5	95.3	89.3	92.7	81.5	86.9	79.9
Red Warba	90.7	82.6	89.2	—	83.8	83.6	86.7	70.6	79.5	38.1	70.7	36.5
Waseca	86.3	92.8	87.6	—	—	—	—	87.5	79.2	34.7	64.9	52.0
Cobbler	84.1	85.2	86.8	84.0	78.5	90.8	87.8	77.1	86.1	37.0	88.2	43.7
Triumph	85.4	79.9	74.7	—	83.2	—	78.0	84.3	84.1	57.5	84.8	39.1
Chisago	87.8	86.8	88.4	90.9	93.1	90.0	91.8	93.3	88.0	58.3	83.7	61.9
Pontiac	86.0	91.9	87.8	—	81.1	81.0	86.3	80.4	90.7	70.7	85.3	75.3
Chippewa	81.2	87.0	85.0	—	69.7	71.6	80.1	76.7	80.9	—	—	27.8
Cherokee	—	89.2	—	—	67.3	83.8	82.4	90.6	—	49.0	82.3	47.8
Satapa	81.2	91.3	91.0	88.6	76.9	86.8	77.4	83.3	77.2	46.1	83.2	67.4
Kennebec	—	88.8	82.5	—	75.4	82.9	—	84.5	—	—	78.5	50.4
Menominee	87.4	78.3	82.9	—	—	—	—	51.6	—	—	68.3	64.1

The dry matter content of the Osseo was slightly lower than the Cobbler in all four potato regions (Table 4).

In the Red River Valley the ascorbic acid content in milligrams per thousand grams was 16.6 and 14.3 for the Osseo and Cobbler, respectively.

A limited number of growers have grown Osseo under the number Minnesota 23 for the past six years. It has given satisfaction as an extra early variety, for early harvest, early market, and for early potatoes for the home garden, particularly on the plains and in the prairie provinces of Canada.

The tubers of Osseo are smoother with a greater width and depth in relation to length of tubers than the Cobbler. A comparison of the two varieties is given in table 5.

TABLE 4.—*Dry matter content of the Osseo and Cobbler varieties in the four regions.*

Variety	Red River Valley Six-year Average 1943-1949 Per cent	Peat Land Two-year Average 1948-1949 Per cent	Late Region Two-year Average 1948-1949 Per cent	Early Market Region 1949 Per cent
Osseo	19.0	15.8	17.4	15.5
Cobbler	20.7	16.9	19.5	16.4

TABLE 5.—*Tuber measurements of Osseo and Cobbler at four locations.*

Location	Variety	Length Cms.	Width Cms.	Depth Cms.
I	Osseo	7.35	7.38	5.74
	Cobbler	8.48	7.17	6.04
II	Osseo	9.04	8.41	6.55
	Cobbler	8.19	6.99	5.60
III	Osseo	8.22	7.94	6.09
	Cobbler	7.73	6.75	5.55
IV	Osseo	8.31	7.45	5.76
	Cobbler	8.12	6.64	5.22
Average All Locations	Osseo	8.23	7.79	6.04
	Cobbler	8.13	6.89	5.60

TECHNICAL DESCRIPTION

Plants distinctly upright and compact, usually with few if any secondary branches. Stems thick, sturdy with prominent, wiry wings, often double. Internodes slightly pigmented. Leaves large with broadly ovate leaflets (length 9.06, with 6.36 centimeters). Inflorescence axillary, few branches, flower cluster compact with usually 6 to 10 flowers. Flowers

white, little if any stainable pollen. Normally non-self fruitful. Tubers, white, round, blocky, smooth, uniform in size, with few if any under two inches in diameter. (Figure 1.)

Summary

The Osseo is an early, quick maturing variety with a distinct upright compact habit of growth. Yields are comparable to Waseca and Red Warba with an exceptionally high per cent composed of tubers above 2¼″ in diameter. Tubers are white, smooth, round, blocky and uniform in size. It should prove useful wherever an extra early white variety is desired.

AN INOCULATION TECHNIQUE FOR THE STUDY OF DRY ROT OF POTATOES[1]

G. W. AYERS[2] AND D. B. ROBINSON[3]

INTRODUCTION

During recent years, potato growers in Prince Edward Island have suffered storage losses caused by the widespread occurrence of Fusarium decay. The causal organism in most cases has been identified as *Fusarium sambucinum* f.6, whereas *Fusarium avenaceum* and *Fusarium coeruleum* have been found associated with rot to a much lesser and minor degree. Preliminary studies have shown that the pathogens causing rot are present in the soil and that infection occurs through wounds contracted during the harvesting and grading of the crop.

Studies reported in this paper are confined to a description of a standard technique suitable for the assessment of soil infectivity and varietal susceptibility. Wounded tubers were used as a selective substrate and the method described is considered to be particularly useful for the testing of large numbers of soil and tuber samples.

SOIL SAMPLING

The standard procedure of topsoil sampling used in soil analyses was followed when collecting soils to be tested for dry rot infectivity. Samples collected at the rate of 100 per acre were bulked to form a composite, and aseptic precautions were observed when moving from one area to another. Infectivity trials were initiated with a minimum of delay, although no lessening of infectivity was apparent when the soils were refrigerated for one month.

THE TUBER SUBSTRATE

All tubers used for inoculation were chosen with a diameter limitation of two to three inches and were selected from stock that had been grown under uniform conditions. The Sebago variety was employed as a selective substrate for testing soil infectivity, because of its high susceptibility to *Fusarium sambucinum* f.6.

Tuber surfaces were cleansed in a washer (Figure 1) constructed on the principle of a rotating drum, with bars and spindle covered with rubber to prevent skin abrasion. This appliance was designed so that fifty tubers could be treated at one time in twenty gallons of water, and it was found that at least ten such lots could be washed without a change of water. A final step in this cleansing process involved rinsing in tap water to remove any loosely adhering spores of the dry rot fungus. Tests with control lots showed little development of rot and this method of cleansing tuber surfaces was found to be superior to surface sterilization with two per cent formalin.

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Contribution No. 1351 from the Botany and Plant Pathology Division, Science Service, Department of Agriculture, Ottawa, Canada.
[2,3]Associate Plant Pathologists, Laboratory of Plant Pathology, Charlottetown, P.E.I.

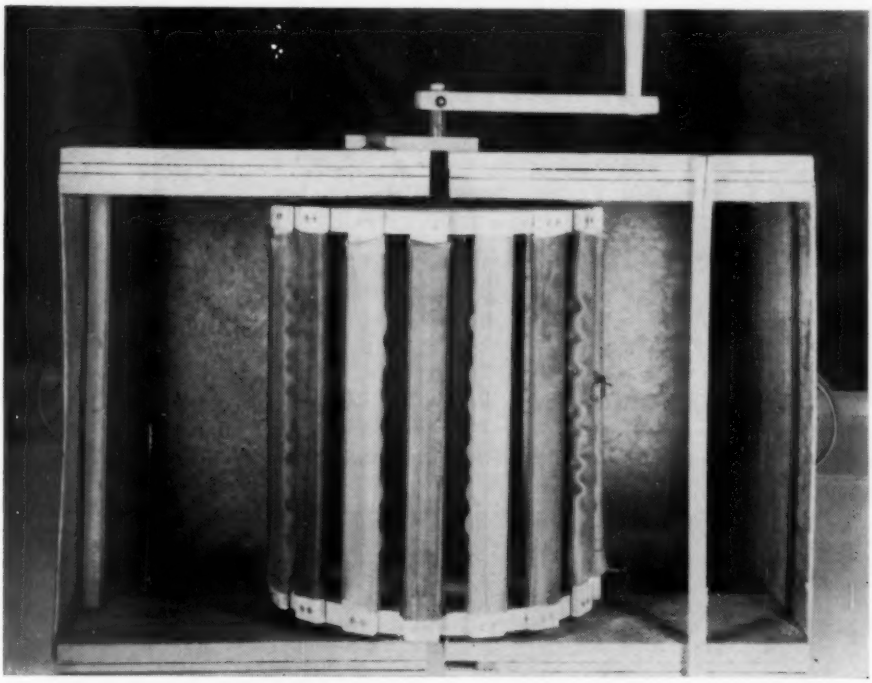

FIGURE 1.—Appliance for washing tubers.

INOCULATION

Tubers for inoculation were first wounded in two places, then dipped in a water suspension of soil or spores as desired. One hundred grams of soil in 1500 c.c. of water were found to be an effective dilution for testing the infectivity of soils. Spore suspension inoculum used in testing the relative susceptibility of varieties could be adjusted to any desired concentration. The most suitable wounding technique was established through trial with six wounds of varying diameter and depth (Table 1) using a three-pronged instrument (Figure 2). This device provided three closely grouped infection courts and infection in one or more of these was counted as a single successful inoculation. Inoculated tubers were stored in clean jute sacks at 40-45° F. The chief advantage of this method of inoculation is that it assures uniform and rapid treatment of the tubers. Two workers can inoculate 300 to 400 tubers per hour.

RECORDING INFECTION

Tuber examinations were made after a period that permitted the rot to become well established. Two months at 40° F. was sufficient, following the use of a highly concentrated spore inoculum, but the disease becomes established much more slowly when the inoculum contains low concentrations of infective elements. Extent of rot was assessed by

TABLE 1.—*The severity of dry rot in Sebago tubers, expressed as a 'rot-index' percentage, following inoculation into wounds of different size.**

Size of Wound (Depth x Diameter in Mm.)	Replicates						Mean	Fiducial Limits P = 0.05	Mean (Angle Transformation)
	1	2	3	4	5	6			
9 x 9	73.3	60.8	68.7	56.2	76.2	59.5	65.8	61.3 — 70.5	54.3
25 x 5	56.2	58.3	54.1	44.1	67.4	59.5	56.6	51.8 — 61.4	48.8
12 x 5	46.2	50.0	44.1	37.5	40.8	40.4	43.2	38.4 — 48.1	41.1
20 x 4	35.8	32.5	46.2	55.8	31.6	47.5	41.6	36.7 — 46.3	40.1
13 x 4	40.4	21.7	44.1	35.4	44.5	34.5	36.8	32.1 — 41.5	37.3
18 x 2	13.7	23.3	31.2	34.1	37.5	27.9	27.9	23.2 — 31.9	31.6
L. S. D. —P = 0.05									2.8

*Randomized block design with individual treatments containing 20 tubers.

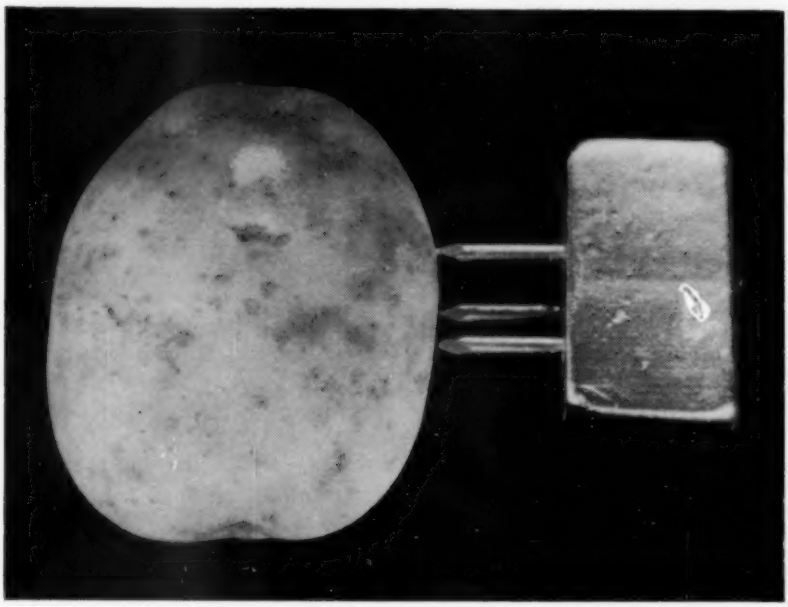

FIGURE 2.—An inoculating device.

slicing the tubers at right angles to the line of the wounds and at about half their depth. The severity of rot was then calculated by giving each lesion a rating of 0 to 6 to denote the extent of the rotted area. These figures were weighted and converted to a percentage called the 'rot index' by the following computation:

$$\frac{\text{sum of ratings x 100}}{\text{number of inoculations x 6}}$$

It is believed that this method gives a reliable index for comparing varietal resistance because it combines susceptibility to initial infection with rapidity of fungal invasion following the establishment of the disease within the tuber. In a comparison of the relative infectivity of soils, however, it is not necessary to go beyond a recording of the percentages of successful inoculations.

Results

The degree of consistency that may be expected from the described method of inoculation is apparent in the results tabulated in table 1. Significant differences between means show the largest, bluntest wounds provide the most suitable infection courts. The fiducial limits show that the mean values are probably accurate within a range of approximately 10 per cent. This is believed to be a reasonably satisfactory level of accuracy for this method of experimental procedure.

The coefficient of variability of this six-replicated test is 11.3 per cent. Other tests of four replicates, but with individual treatment lots comprising 25 tubers, were found to give results well within this range of variability and such a design is therefore considered to be an adequate experimental unit for dry rot tests using the technique outlined in this paper.

Discussion

The use of tubers as a selective growth medium for dry rot pathogens is the best means now available for dry rot studies that involve the assessment of soil infectivity or varietal susceptibility. This method of biological assay has been used by a number of workers, notably Foister *et al* (1) McKee and Boyd (2) and Small (3). The techniques used by these workers, however, require the individual hand inoculation of each wound. The method herein described of using a 'triple' wound followed by immersion of the tuber in a suspension of the desired inoculum combines a satisfactory degree of consistency with greater speed in experimental procedure.

Summary

An inoculation technique for the study of dry rot of potatoes is described. It consists chiefly of a standard procedure of tuber wounding and exposure to inoculum adaptable to estimations of soil infestation or varietal susceptibility. Results are expressed as a 'rot index' percentage based on the combined figures of the number of successful inoculations and the extent of decay in tubers contracting the disease.

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POTATO EMBRYO CULTURE[1]

F. L. HAYNES[2]

This study was undertaken as one phase of an investigation of seed dormancy in *Solanum tuberosum*. The experiments were originally conducted to determine whether embryo dormancy was responsible for the seed dormancy. The seed dormancy was found to be caused by factors other than embryo dormancy. These factors will be discussed in a later publication. When the embryo was found to be capable of continuing growth to the seedling stage, under proper conditions, both before and at the time of seed maturity, a successful method was developed for culturing immature embryos. The method is a possible tool for potato breeders in securing progenies from certain difficult crosses within the species and might prove useful in obtaining progenies from some interspecific crosses.

METHODS

All crosses used in this study were between varieties and breeding lines within *Solanum tuberosum*. The crosses were made by hand pollinations in the greenhouse. All lines used would cross normally, with no more difficulty than one encounters with any potato hybridization. The age of embryos being excised was measured in days from time of pollination.

All excision and transplanting of embryos was done in an isolation chamber or cabinet which had previously been sprayed with a one per cent aqueous solution of phenol. Before opening, the fruits were surface sterilized for ten minutes in a 10 per cent "Clorox" solution. All instruments were dipped first in 50 per cent ethyl alcohol and then in 50 per cent hexylresorcinol (trade name ST 37) between operations to minimize contaminations from micro-organisms. With this method less than two per cent of the cultures were lost from contaminations. The excision of the embryos was performed with the aid of a stereoscopic dissecting microscope.

The embryos were transplanted to glass screw-cap vials on 5 cc of medium. The culture medium used was that reported by P. G. Smith (1) for tomato embryo culture. Smith used a modification of White's (2) medium.

After the embryos were transplanted, the vials were transferred to temperature control chambers where fluctuations in temperature were no greater than plus or minus 1 degree centigrade.

Data were recorded as numbers of seedlings produced. A seedling was counted when it reached sufficient size to be transferred to soil and be capable of continued growth.

[1]Accepted for publication February 15, 1954.
Paper No. 307, Department of Plant Breeding, Cornell University, Ithaca, N. Y.

[2]Assistant Professor of Horticulture, North Carolina State College. This work is a part of the research problem presented in a major thesis in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Cornell University, Ithaca, N. Y.

Procedure and Results

The first experiment was designed to demonstrate the effect of temperature on the growth of excised embryos. Seeds from mature fruits of two lines were used. The seeds were taken directly from the fruits, the embryos exposed by cutting away most of the endosperm, and placed immediately on the culture medium, one embryo per vial. Ten embryos of each line were stored at each of three temperatures; 15, 20, and 25 degrees centigrade. The experiment was duplicated.

Counts of the number of seedlings produced were made on the 7th, 15th, and 18th days after transplanting. The experiment was terminated on the 18th day, when it was found that all embryos stored at 20 degrees had produced seedlings. The vials were kept for an additional twenty days. All the embryos eventually produced seedlings, but no data were recorded after the 18th day, since temperature effect was being measured. Twenty degrees centigrade was the best of the three temperatures used. A summary of the results is presented in table 1.

Table 1.—*Mean percentage of seedlings produced from excised embryos at three temperature levels.*

Temperature Degrees C.	Line # 1	Line # 2
15	70	85
20	100	100
25	65	60

L.S.D. 5 Per cent level = 24

A second experiment was designed to show the effects of the age of the embryo and the method of excision upon subsequent growth. Fruits from the two crosses Houma x F3M301 and Katahdin x F3M201 were used. Fruits were harvested at three-day intervals beginning on the 8th day after pollination and continuing to the 35th day, when the seeds were mature. Immediately after harvest, ten developing seeds or embryos from each of three treatments for each cross were removed and transplanted to the culture medium. The experiment was duplicated, giving a total of forty individuals in each treatment for each age level. The three methods of excising and transplanting were: (1) excision of the intact endosperm and embryo—*i.e.* the whole ovule; (2) complete excision of the embryo; and (3) excision of the whole ovule, as in treatment 1, and after ten days the complete excision of the embryo from the endosperm. The excised embryos from treatment 3 were transplanted on fresh medium. All vials were stored at 20 degrees centigrade.

Data were recorded on the 30th day after transplanting, or twenty days after treatment 3 was completed. The results for three transplanting dates are given in table 2.

The transplantings made on the 8th and 11th days failed to grow. The embryos were not sufficiently developed to continue growth. Treatment

TABLE 2.—*Total number of embryos that grew from 20 transplanted,—from each of two crosses under three treatments.*

Transplanted — Days after Pollination	Treatment	Excised	Grew
14	1	40	0
	2	0	0
	3	38	38
17	1	40	0
	2	40	39
	3	35	35
20	1	40	0
	2	40	38
	3	29	26

2 could not be included for those age levels, as well as for the 14th day, because of the size of the embryos.

Treatment 3 was difficult to perform in all ages, and after the 23rd day it was abandoned because so few embryos were excised without injury. The reduction in number of embryos for this treatment at the 17th and 20th days represents the number injured in excision. The only advantage derived from using treatment 3 was that of being able to take embryos three days earlier.

An interesting result of this experiment was that from the 14th day age level all whole ovules which were transplanted (*i.e.* treatment 1) continued to grow, and mature seeds of normal appearance were produced. Most of these seeds were dormant at maturity, but in the 23rd day and older age levels a few germinated and produced seedlings on the culture medium. In the groups younger than 23 days they failed to continue growth beyond the stage ordinarily attained by morphologically mature seeds. An examination of these seeds showed normal appearing embryos and endosperm.

A histological study of serial sections of developing embryos, using the same ages as described in the previous experiment, showed that at 11 days, as you will observe in figure 1, the average embryo was composed of 16 cells. At 14 days (Figure 2) it was much larger, but still spherical in shape. At 17 days (Figure 3) it was still larger and considerable elongation had taken place. The rudimentary condition of the embryo at 11 days and 14 days is probably partially responsible for the failure to get growth from the younger stages.

Following the growth of the embryos to seedling stage in the dark in temperature control chambers, the vials were removed and placed in the light. When the cotyledons had developed a normal green color, a sample of 40 seedlings was transferred to a mixture of half vermiculite and half potting soil in clay pots. Of the 40 seedlings transferred, 32 lived and grew normally.

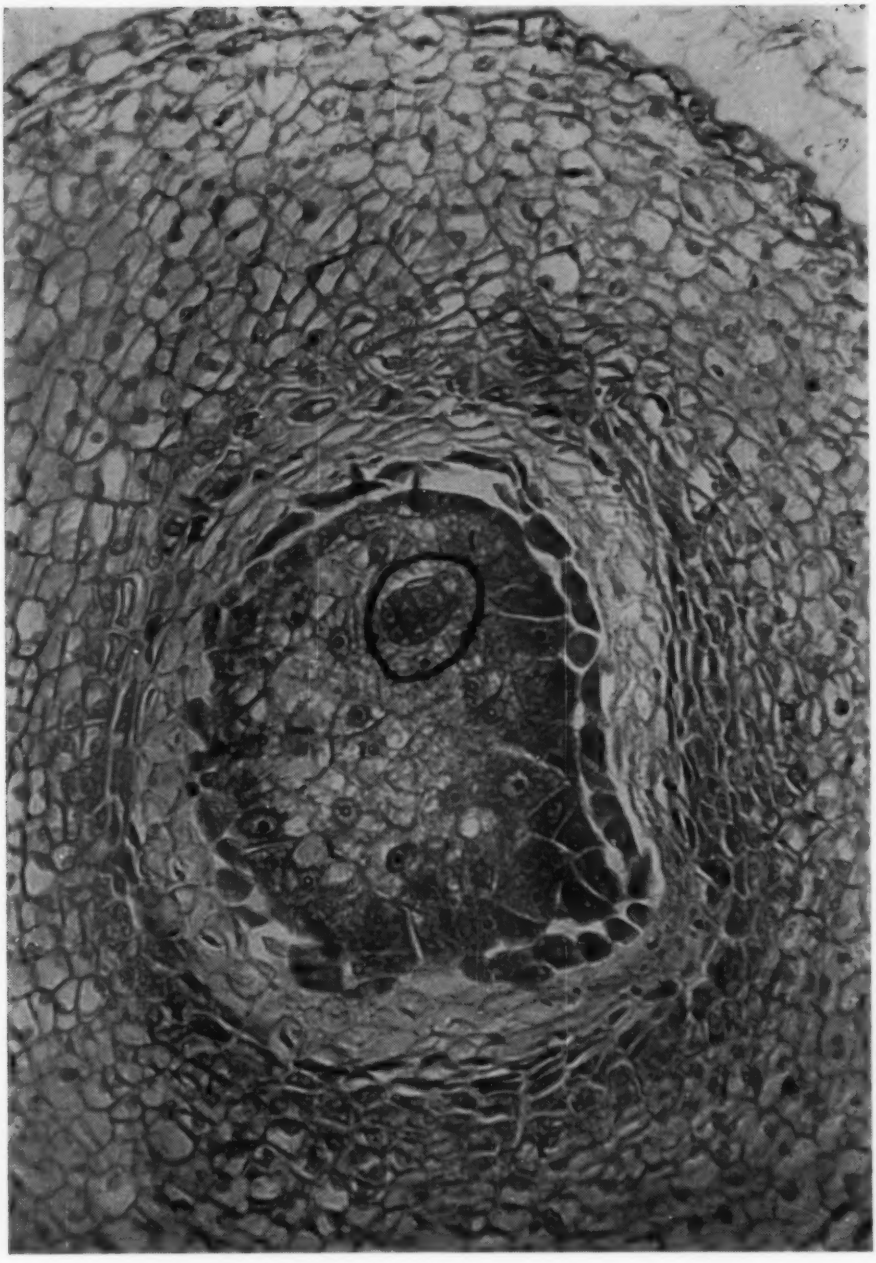

FIGURE 1.—Photomicrograph (X 400) of a section of a developing potato seed 11 days after pollination. The embryo in encircled.

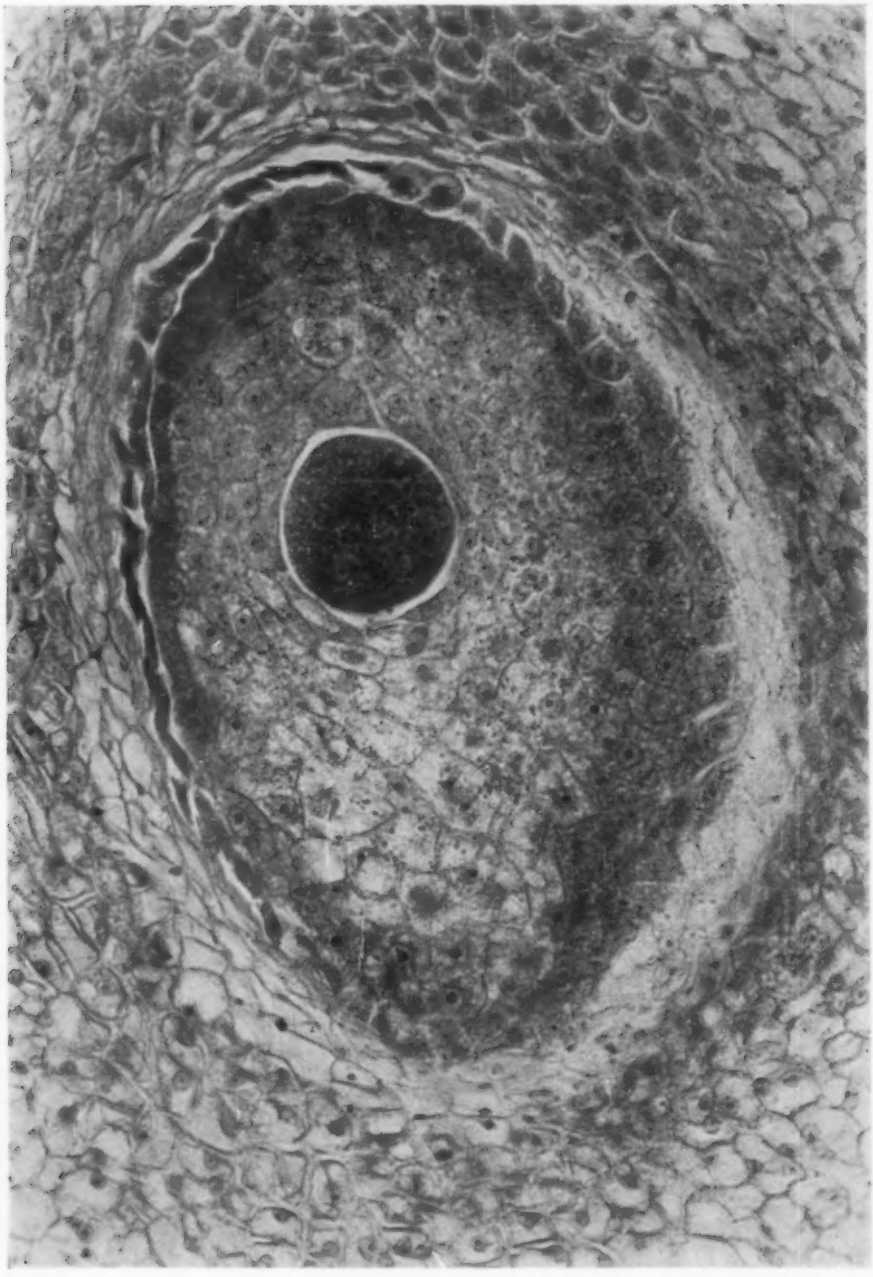

FIGURE 2.—Photomicrograph (X 400) of a developing potato seed 14 days after pollination.

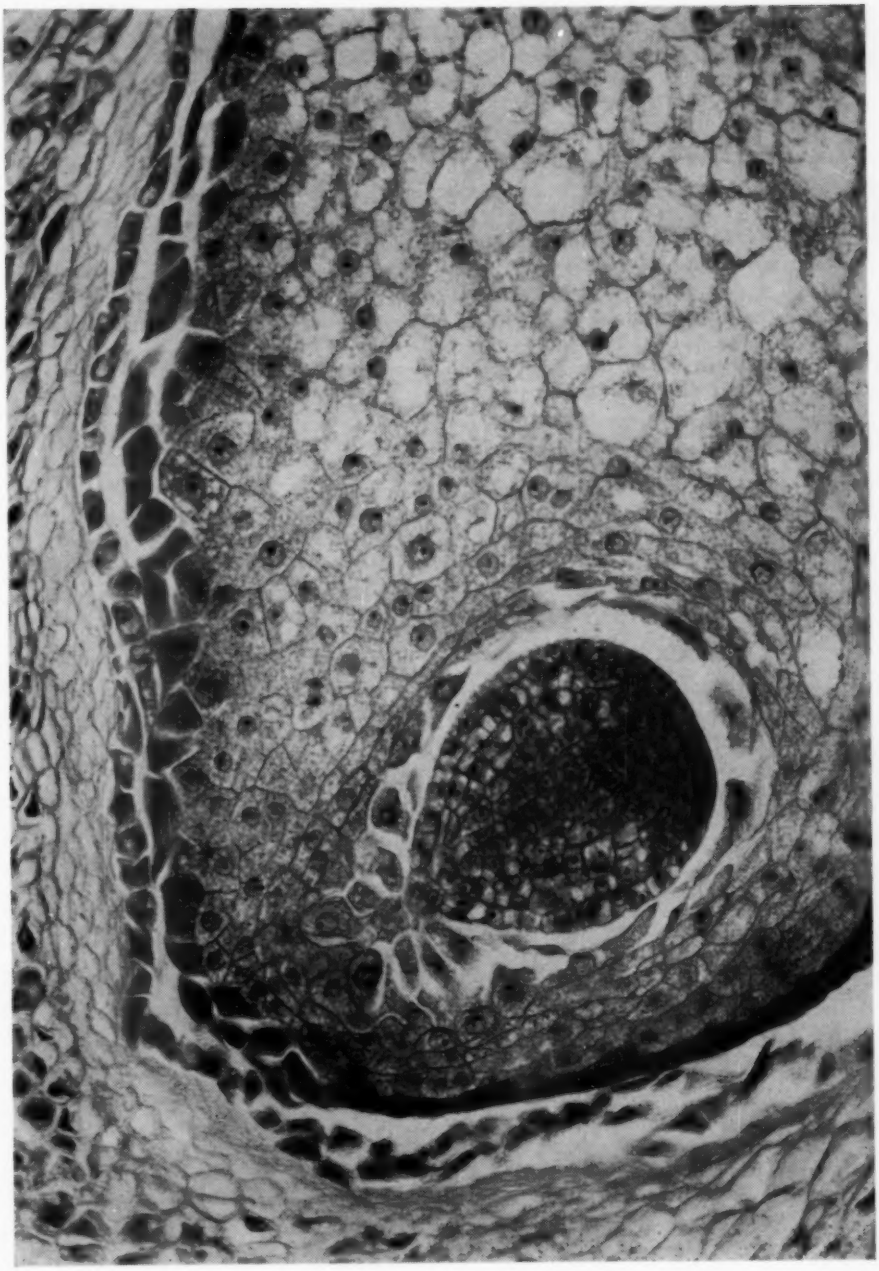

FIGURE 3.—Section of a developing potato seed (X 400) 17 days after pollination.

Summary

Immature embryos of the potato were cultured *in vitro*, and grown to seedlings of a size that could be transplanted to soil in pots. Embryos excised and transplanted to culture medium seventeen days after pollination were grown successfully.

Embryos may be cultured as early as fourteen days after pollination provided whole ovules are transplanted to the culture medium, and if the embryos are excised from the ovules and re-transplanted about ten days later.

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POTATO NEWS AND REVIEWS

THE 1954 POTATO CROP SITUATION AND THE UTILIZATION OF SOME PREVIOUS POTATO CROPS[1]

A. E. MERCKER[2]

It was with the utmost pleasure that I accepted your enterprising secretary's request to participate in the marketing program at your annual meeting. I wish for you the best meeting that has ever been held. Formerly I participated in several winter meetings, and occasionally in a summer field demonstration. At the winter meetings, however, there was always the question as to whether or not the weather would permit one's participation. You have eliminated this possibility by changing the season of your meetings. In late January it was my pleasure to be on the program of the National Potato Chip Institute at Cincinnati, Ohio. During a visit to the auction of perishable commodities in that city I saw a car of Red River Valley potatoes auctioned for the benefit of a humane cause for the very large total of $30,000. I believe this is the highest price ever received for a car of potatoes.

Potato production and marketing conditions are constantly changing. Let us review some of the changes that have taken place. Potatoes are now produced on 2 million fewer farms than produced them a score of years ago. Production is highly concentrated, in that about 80 per cent of the total potato crop is produced on less than 2 per cent of the farms growing potatoes, or about 30,000 farms.

CHANGES IN PRODUCTION AND MARKETING

Preparation for sale has changed from the simple method of hand picking and packing a large proportion of the crop in the field, often in uneven weight sacks, to handling in central packing houses. The larger sacks have given way to 100-pound sacks, and this in turn is giving way to small packages, so that about 20 per cent of the potatoes sold for food are packed in consumer-size packages containing not over 25 pounds of potatoes.

The Cobbler and Bliss Triumph, once the leading varieties grown in this area, have been replaced by newer varieties which are more productive. Research has played a dominant role in these changes by increasing yields through developing better varieties, raising the quality of certified seed, supplying the proper plant nutrient, and more completely controlling diseases and pests. Research engineering developed mechanical harvesters, mechanical loading, and storing and grading equipment that minimizes storage losses and shrinkage. These mechanical advances require a larger investment in equipment, so that production is being concentrated in the hands of larger producers.

SHIFTS IN AREAS OF PRODUCTION

Production is also shifting so that the 13 early States now produce about 15 per cent of the total crop, and the late States 80 per cent,

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Presented at the Annual Meeting of the Red River Valley Potato Growers Association Grand Forks, N. D., June 22, 1954.

[2]U.S.D.A. Agricultural Marketing Service, Fruit and Vegetable Division, Washington, D. C.

whereas the 7 intermediate States are squeezed to the small proportion of 5 per cent of the crop. In the late States, production decreased in the North Central States by 15 per cent, and increased by nearly that amount in the western States. The East has about maintained its historic production level.

Within North Dakota and Minnesota, shifts in production are still taking place. During the period 1909-1918, New York State was the leading producer of potatoes, averaging about 37 million bushels. During the next 10-year period, 1919-1928, Minnesota led with an average annual production of 34 million bushels. Since then, Maine has led the country, averaging over 52 million bushels during the last three years, followed by Idaho and California. The production trend for North Dakota is upward, but the combined average production of both North Dakota and Minnesota during the 1951-1953 period was slightly less than 27 million bushels, or 82 per cent of their average production during the 1929-1938 period of 32.6 million bushels. This 1951-1953 average production of 27 million bushels, however, was obtained from 34 per cent of the average acreage planted during the 1929-1938 period. In Minnesota the producing areas are shifting to the north and west and in North Dakota from the southeast to the northeast. As available water is found for irrigation purposes, no doubt further shifts will be made in the producing areas.

Reduction in Consumption

Consumption *per capita*, has declined steadily in nearly all of the last 50 years, but in my opinion reached a low point of 96 pounds per person in 1952. The total quantity consumed ranges from 260 - 290 million bushels. The increase in consumption in 1953 to 104 pounds, however, is due largely to the increased quantities that are used for food processing. The quantities used by processors have shown a phenomenal growth, — from less than 2 per cent of the total sold for food in 1940 to 13 per cent in 1953, or from 5.4 million bushels to about 39 million bushels. This is equivalent to 15 pounds *per capita*. Potato chippers used 29 million bushels, the frozen French fried industry 3½ million bushels, and the potato flour manufacturers, potato canners, canners of hash and stews used about 3½ million bushels. Dehydrators used about 3 million bushels. Consumers are evidently willing to pay for the services rendered so as to receive potatoes in ready-to-eat form. Restaurants used about 63 million bushels, or 22 per cent of the total used for food, and this includes the 2½ million bushels of prepeeled potatoes. The prepeeling industry also is growing. The remaining quantity of 160 to 190 million bushels is sold through retailers and it is in this outlet that the decline in consumption is greatest. It is here that the industry must expend the major part of its efforts if it is to persuade the homemaker to increase her use of potatoes.

1954 Crop Prospects

Now I would like to say something about the 1954 crop prospects. A year ago the January 1, 1953 carryover from the 1952 crop was about 114 million bushels. The spring and winter States, which market their crops during the first half of the calendar year, produced 58 million bushels in 1953. This made a total available supply of 172 million bushels for sale during the first six months of 1953, of which 5 million bushels of early potatoes were dumped. Under such supply conditions prices collapsed

to very low levels so that the 1953 crop farm price is estimated at 79 cents per bushel, or 50 per cent of parity. In the past, such low prices resulted in sharp cuts in acreage. We now, however, have three moderating factors that offset acreage reductions: (1) the relatively low transportation costs of the potatoes that are produced near our large centers of population, (2) the tax reach-back whereby some operators offset profits with the previous year's losses, and (3) the disposition of the acres that may be diverted from the basic crops. These factors are evidently modifying growers' intentions to reduce acreage.

The United States Department of Agriculture released some months ago the acreage and marketing guides for the 1954 potato crop. In the early commercial winter and spring States, the guide suggested the planting of 148,000 acres and a crop of 42 million bushels. The June 10 crop report indicates about 152,000 acres planted in these areas and production is indicated at 45 million bushels. When this indicated production is added to the 120-million bushel carryover of old potatoes on January 1, we have a total available supply of 165 million bushels available for sale during the first six months of 1954, which compares with the 172 million bushels available for sale during the first 6 months of 1953. Of course only 167 million bushels were sold last year because about 5 million bushels were dumped.

The job ahead of us is still tough. The March 1 report on intentions to plant indicates that growers intend to plant 168,000 fewer acres, or 11 per cent less than a year ago. Indicated plantings are less in all regions, with the largest reduction of 23 per cent in the early States, followed by a 12 per cent reduction in the 7 intermediate States, and 8 per cent in the late States. The total indicated acreage of 1,364,000 for 1954 is about as recommended in the Department's guides. Growers should not be misled into easing up on the acreage adjustment plans, as several States or areas that have yields well above the national average indicated that their reductions are moderate and they intend to plant an acreage substantially above the acreage guide.

If these intentions to plant are fulfilled and recent average yields are obtained, a 1954 crop of about 347 million bushels is likely which would represent production of 51 million, 15 million, and 281 million bushels respectively in the early, intermediate, and late States.* These figures compare with the 1953 production of 66, 18, and 290 million bushels, respectively.

The early and intermediate States made a good adjustment in their plantings and earnestly tried to stay within the acreage guides established by the Department of Agriculture. The record yield indicated in these States, however, will produce a crop somewhat (5 per cent) in excess of the total early commercial production guide. These areas, however, really tried to adjust their production downward compared to 1953. Prices responded favorably to this adjustment; in fact, so well that producer prices are appreciably higher than those of a year ago.

The likely production of 281 million bushels in the 29 late States is only about 2 million less than the 1952 production when prices weakened toward the last third of the marketing season. If the late State potato

*The U.S.D.A. crop estimate for July 1 indicated a crop of 345,622,000 bushels.

growers desire to avoid a similar situation, they would do well to bring their production within the marketing guide of 272 million bushels.

Once prices are down, they are hard to raise. When the carryover of late potatoes has disappeared in late June, price prospects should gradually improve further as the available supply more nearly adjusts itself to demand. The indicated crop is on the ample side.

Use Outlook and Planting Guides

Growers, shippers, and members of the allied industries would do well to pay more attention to the guides and other economic information available to them. If they would do one-tenth as well in adopting outlook information as they did in accepting the production techniques that have been developed by our agricultural colleges and experiment stations, they would extend their periods of prosperity by producing within reasonable limits an ample supply of potatoes without undue surpluses.

In addition to production adjustments, mechanisms and facilities to divert surpluses to other uses are available. Such diversion requires wholehearted cooperation by the industry, however, to withhold the smaller and low-grade potatoes from the market. The machinery is there to do it. There are instruments that can be adapted which regulate the size and quality of potatoes that can be shipped. However, such instruments are not of any value unless the industry wholeheartedly supports them.

Divert Low Grade Potatoes

There are many useful outlets for low-grade potatoes. They can be diverted to industrial products or to livestock food. The Experiment Stations in this area have conducted many valuable feeding experiments that clearly demonstrate the success in feeding potatoes to livestock. Should a systematic program be adopted whereby the inferior potatoes could be diverted to feed or industrial uses, there is no doubt that this action would help the market situation as well as the reputation of the potatoes shipped from this area.

Consumer-Size Packages

As I mentioned before, there is a trend towards packaging potatoes in what are commonly called consumer-size packages. In my opinion, there is little doubt as to where such packaging should be done in the late States. It can be done most efficiently at country shipping points, since the late crop is well matured and dependable help can be taught to do a good job and hired for a reasonably long period of time. This is not true in the early areas, where the shipping season is short and the crop is perishable or lacks suitable maturity. However, the retail outlet is interested in (1) a good quality pack; (2) a package containing not less than the marked weight; (3) dependability in the quality and continuity of such a supply; and (4) prompt and dependable delivery and services. Consumer packaging started in the producing areas.

One of the most serious problems in small packs is in delivering a package containing the proper net weight to the retail store. This is very important. The delivery may be 7 to 10 days or more after the car was shipped and longer than that from the date of packing. Then the small packages may be in the retail stores several days. During all this time the potatoes lose weight through loss of moisture. Local weights and measures

inspectors are alert. Short weight can easily be established and is dealt with severely in the courts. The weights and measures ordinances are rigidly enforced, and the homemaker also is alert to weight.

The weights and measures inspectors are primarily interested in whether or not the potatoes equal the weight marked on the individual packages. Average weight does not count. The retailer is held responsible for the weight on the package and it is most embarrassing for him to be listed as having sold short weights. To meet these conditions it is necessary to include an overage of weight. Because of the failure to meet some of the retailer's requirements, enterprising individuals in the terminal markets started repackaging potatoes, and that practice is increasing in the terminal markets. This is a direct merchandising challenge to the industry in the producing areas, and shippers must be on their toes to fulfill the rigid requirements of the retailers if they are to increase their proportion of this dependable business.

Seed Potatoes

So far, I have said nothing about your seed potatoes. This area comprises the second and third leading States in production of seed potatoes, and produced about 22 per cent of the total United States supply of 1953 crop certified seed potatoes. About one-third of your potato production consists of certified seed. As acreage has been declining, the use of seed has declined, even though a larger quantity is used per acre. The marketing agencies for your seed producers and the State certifying agencies have performed a wonderful and difficult job.

Through continuous, well-directed efforts, you may be able to obtain a larger proportion of the domestic seed business. That means, however, producing a supply that always will meet the expectations of the planters. You have made a good start in the field of seed exportation. I have always felt that we should make further attempts to obtain a larger proportion of the Latin American business. Those countries generally require that the certified seed specifications and programs of the seed-producing country or State be registered with their Ministry of Agriculture.

Promotion of Seed Sales

In order to stimulate sales, you might seriously consider making a colored sound movie in the language of the country or countries in which you desire to sell the seed. Such a movie should clearly demonstrate the seed certifying program, including all the available facilities and their functions. It should include demonstrations of the meticulous care with which you select the original potatoes that you use to start your foundation seed program, and all the details of preparation for planting, growing, storing, and marketing your seed. Sales to Latin America may also involve some financing, in addition to collection of the proceeds from the sale. The business is there, but you must grow the varieties that the importing country wants and then sell them. Such trade could also develop a better relationship and understanding between the producers of the several countries.

I know you will always produce potatoes. There is a place for good quality, good-appearing, well-graded, washed, and packed potatoes. A steadier demand will be developed because of the careful study that many of you are giving to potato marketing and the desire to produce, pack,

and market potatoes for special uses, combined with rapid diversion of low grades. This will help avoid the violent ups and downs in prices from year to year, resulting in greater stability of income from potatoes.

ASSOCIATION LISTS MOVIES AND FILMSTRIPS ON MARKETING FRESH FRUITS AND VEGETABLES

A catalog of motion picture films and filmstrips dealing with production, harvesting and marketing of fresh fruits and vegetables has been compiled by the United Fresh Fruit and Vegetable Association. The list contains titles and descriptions of 60 movie films and filmstrips, many in color. These are obtainable for showing at local trade meetings, conventions, schools and before consumer groups.

Each picture tells the story of one or more phases of the fresh fruit and vegetable industry from planting, harvesting and shipping to wholesale and retail distribution. All have been prepared under the direction of practical produce men, and some are veritable travelogs combining colorful action with romantic backgrounds. The catalog, which tells where and how to get these films, is available from the United Fresh Fruit and Vegetable Association, Information Department, 777 Fourteenth St., N.W., Washington 5, D. C., at 50¢ per copy.

NORTH DAKOTA POTATO TOUR

The first North Dakota sponsored potato tour since World War II brought potato men from all over the Valley to Grafton the last week in July.

Some 15,000 residents of the Red River Valley of the North crowded Grafton streets for the parade, the coronation of the Potato Queen and other events.

Potato men from throughout the Valley were there to see the huge potato machinery display. In keeping with the general theme, Grafton, "Spud Row of the North," was decorated with potato bag pennants and flags. Those participating in the tour were honored guests at the functions of the Potato Day observance. The afternoon parade featured five bands, 28 queen candidates, color guards and Grafton's marching clown band. Also featured was a huge salad bowl containing some 1,500 pounds of potato salad which was served free to all visitors. The day's events concluded with street dances.

The first day of the North Dakota State potato industry tour started in Grand Forks on Monday, July 26th, and ended with a picnic lunch at Northwood Park, Wednesday, July 29th. Stops were made to view potato fields and various methods of cultivation used by many of the leading growers in the region, fertilizer and insecticide test plots as well as large, new and modern table potato processing plants.

Seldom if ever in the history of the state has the certified seed potato crop looked better than it does this fall. Because of generally dry conditions, the crop is not expected to be large. This, however, should produce seed of desirable size and insure extra vigor. Varietal purity of the seed, breeding "know how" acquired through years of strict certification has produced seed of unsurpassed quality. Careful seed selection and roguing has been practiced so dilligently that most fields show practically no disease.

The majority of the field readings show from none to less than one-tenth of one per cent virus. Potatoes are coming out of the ground bright in color, smooth skinned, a picture of perfection. North Dakota certified seed potatoes have brought a premium in the markets for a number of years. This year's crop certainly should be no exception. In fact, it is expected to be one of the nicest seed quality crops in North Dakota's fine record of seed production.

The many new and modernized processing plants now operating in North Dakota also should insure very high class table potatoes.

RESULTS OF 1953 FUNGICIDE TESTS PUBLISHED

"Results of 1953 Fungicide Tests," reprinted from a series of articles which appeared in Agricultural Chemicals from January through March, may be purchased in bound and covered form for $1.00 per copy by sending orders with remittance to Dr. W. D. Mills, Department of Plant Pathology, College of Agriculture, Cornell University, Ithaca, New York. The publication of these results is under the sponsorship of the American Phytopathological Society. It is, really, a continuation of the publication of results formerly provided through a supplement of the Plant Disease Reporter, Plant Disease Survey, United States Department of Agriculture. The underwriting of this project was accomplished through contributions from many commercial companies identified with the Pesticide Industry.

The Temporary Advisory Committee on Collecting and Disseminating Data on New Fungicide Tests of the American Phytopathological Society arranged for the recent publication of data and the establishment of a program for annual publications of Fungicide Test Results in the future. Dr. D. A. Roberts, Department of Plant Pathology, Cornell University, Ithaca, New York, will be in charge of this project during the current year.

AMERICAN POTATO YEARBOOK

The 1954 edition of the AMERICAN POTATO YEARBOOK has just come off the press. It is again edited by John C. Campbell, Rutgers University College of Agriculture, and contains 80 pages of vital information to the potato grower, shipper, dealer and all those with an interest in the potato industry.

A special feature is the excellent aticle on "The Utilization of the Potato Crop and the Demand and Supply of 1953 and 1954 Crop Potatoes" by A. E. Mercker of the United States Department of Agriculture. There is also a fine article on the National Potato Council, written by William M. Case. A new addition to this year's book is complete information on United States Grade Standards for Potatoes. In addition, there is a current list of recent references to potato culture in the United States as well as the names of the one hundred leading potato growing counties.

Other interesting items include articles on potato production, rules and regulations affecting the shipment of seed potatoes, a list of leading United States and Canadian associations engaged in the improvement of

the potato industry together with the names of United States and Canadian seed certification officials. The YEARBOOK also gives information on how and where to secure helpful brochures and leaflets covering every phase of the potato industry.

The new volume also contains much statistical information of value. There are tabulations by states of both seed and table stock production as well as statistics on Canadian and world potato production.

Copies of the YEARBOOK may be secured from the AMERICAN POTATO YEARBOOK, 8 Elm Street, Westfield, New Jersey. An individual copy sells for $2.00. A complete volume, 1948-1954, is available at a special price of $6.00.

BETTER METHODS FOUND FOR STORING POTATOES IN EASTERN AREAS

Efficient methods of storing white potatoes in the New Jersey, Long Island, and Southeastern Pennsylvania area — including design and layout of storage structures — are presented in a publication issued recently by the U. S. Department of Agriculture.

Based on research by the Department at the New Jersey Agricultural Experiment Station with the cooperation of the experiment stations of New York and Pennsylvania, the resarch report points out that potatoes can be stored for as long as eight months after harvest, "a practical method of minimizing price fluctuations in local markets," if recommended storage conditions are observed.

While either refrigerated or common storage structures are suitable for the middle eastern area, higher initial and operating costs tend to make refrigerated storage economically impractical for potatoes, the publication explains. Recommended are insulated, above-the-ground structures having a forced ventilation system. The report describes types of storage structures and ventilating systems, including controlled methods of air circulation.

A section on suggested design and construction of new storage houses deals with capacity, wall construction, roof design, insulation requirements, floor design, and floor ventilating and unloading ducts. Drawings and pictures illustrate the directions given for construction of new facilities.

Suggestions also are given for modifying existing storage houses to make them more efficient.

Single copies of the publication, "White Potato Storages for New Jersey, Long Island and Southeastern Pennsylvania," Marketing Research Report No. 70, are available from the Marketing Information Division, Agricultural Marketing Service, U. S. Department of Agriculture, Washington 25, D. C.

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General Industrial Co. announces production of a new portable WIRELESS intercom. Simply plug into any standard 120 volt AC or DC outlet and it's ready to go to work for you! Compact, 2-way, portable intercom requires no wires, installation or extras! Saves time, ups business efficiency. Simplifies office-to-shop, stockroom-to-sales floor, inter-depart-

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ERRATUM

In the article entitled "Results of Potato Seed-Piece Treatment Tests in Kern County, California" which appeared in the August, 1954 issue (Volume 31, No. 8) two paragraphs should be re-arranged as follows:

On page 246, the four paragraphs under "Review of Literature" should precede the caption "1951 Experiments" which appeared on page 247.

The last paragraph starting on page 246 and ending at the top of 247 belongs to the section "1951 Experiments."

Potato growers and the Rohm & Haas Company, Philadelphia, manufacturers of agricultural chemicals, both want to see more potatoes consumed — the growers so they will have a bigger market for their crop, the company so demand for its fungicide, Dithane, will be increased. This unusual poster recognizes this shared interest. It is being posted this summer in selected potato-growing areas to help dealers sell more Dithane. Rohm and Haas Company was one of the first industrial advertisers to employ the outdoor medium in support of products of this type. Other media include farm papers, rural newspapers, radio and business papers.

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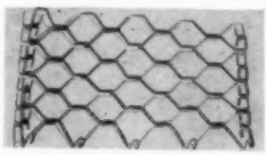

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Potash and Potatoes

Growing potato plants will show their need for potash by leaves that have an unnatural, dark green color and become crinkled and somewhat thickened. Later on, the tip will become yellowed and scorched. This tipburn then will extend along the leaf margins and inward toward the midrib, usually curling the leaf downward and resulting in premature dying. It pays to watch for these signs, but it is far better practice to fertilize with enough potash so as never to give them a chance to appear.

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